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(54) APPARATUS FOR CUTTING DRAINAGE TRENCHES

(71) We, MACHINEFABRIEK D. BARTH & ZN. B.V., of Mijlweg 23, 'S-Gravendeel, Netherlands, A Dutch Body. Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for cutting drainage trenches in the earth, in particular to receive drainage tubes or pipes, comprising a cutting tool with spaced, usually parallel, planar sides and a front face extending rearwardly and upwardly from a shart tip at the lower forward extremity of the tool so as to form a flat sided flat-bottomed narrow trench when forced through the earth.

For controlling the depth of said trench in known apparatuses the entire tool is tilted backwards for digging less deep and forward for digging said trench deeper. This implies several disadvantages, however. When adjusting for, e.g. digging less deep, the leading tip of said tool is moved up against the forces which are exerted on the inclined upper forward side of said tool, whereas the bottom of said tool is lifted somewhat at the front, by which the pressure on the bottom of the trench is only transferred by the rear portion of said tool bottom, causing said rear portion to be pressed deeper into the earth, which is the opposite effect to that which was aimed at. When adjusting for digging deeper, the point of said tool is directed downwards, so that the rear end of the bottom of said tool lifts from the bottom of said trench. Here the forces exerted on the inclined upper side of said tool are only absorbed by the front portion of the tool bottom of said digging element, which effect may force the tool deeper than was intended.

The present invention resides in apparatus for cutting a drainage trench, comprising a cutting tool mounted on supporting means for attaching the tool to a vehicle, the tool having spaced planar side members embracing the supporting means, and a front member spanning the spacing between the side members at the leading edges of the latter, the said leading edges and front member extending rearwardly and upwardly from a sharp tip of the tool at a lower forward extremity of the tool, and at least part of the tool being pivotable about a horizontal axis disposed close to the said tip.

The entire tool, or only the tip region of the tool may be pivotable about the said axis with respect to the supporting means. Alternatively the tip region may be fixed relative to the supporting means, the rest of the tool being pivotable about the said axis. In the last-mentioned case, or if the entire tool is pivotable, the supporting means is preferably an L-shaped member with an upright arm for attachment to a vehicle and a generally horizontal arm at whose free end the tool or part thereof is pivotable.

Three embodiments of the invention are shown in the accompanying drawings in which:—

Figure 1 is a side view of a trenching machine with a trench-cutting tool which is rotatable as a whole;

Figure 2 is a side view of a tool of which only the tip region is pivotable;

Figure 3 shows on a larger scale part of the tool represented in Figure 2; and

Figure shows a tool in which the tip is rigidly connected to a main beam, whereas the rest of the tool can freely rock about a pivot on the main beam.

Figure 1 shows a crawler tractor vehicle 1 provided with apparatus for cutting a drainage trench in the ground and laying a drainage tube in the trench. The tractor has a conventional drive and carries a fixed anchorage 6 and a parallelogram linkage 2 of which one upright side member 4 is mounted on the tractor for pivoting about a horizontal axis 5 at the bottom of the member 4; this axis is perpendicular to the normal direction of movement A of the tractor. A hydraulically powered piston

[Price 33p]

cylinder actuator 7 couples the member 4 to the anchorage 6 so that the member 4 and hence the entire parallelogram linkage 2 can be tilted forwards or backwards. An automatic control device 8 is mounted on the member 4 and controls the actuator 7 so as to maintain the member 4 in a predetermined position relative to the vertical regardless of the position of the vehicle, e.g. if the surface of the ground is uneven. The member 4 may for example be automatically kept vertical. Actuator 7 therefore acts as a stabilizer.

The parallelogram linkage has rearwardly extending top and bottom members 9, 10 and an upright rear side member 3 which is a supporting beam for a trench-cutting tool 14.

Between the pivot 11 on the member 4 and a fixed point 12 of said parallelogram arm 9 a main hydraulically powered piston cylinder actuator 13 is arranged, by whiich the shape of said parallelogram linkage 2 and consequently the height of said beam 3 can be changed. A shuttle box 15 is positioned behind the tool 14; drainage tubes are supplied into the box from above, pass through the box and are discharged at the rear and lower side of said shuttle box so as to be disposed in the trench made by the tool 14. The tool 14 is composed of two flat vertical parallel side plates 17, of which the rear edges extend vertically and are connected by a plate 18. The bottom edges of the plates 17 are connected by a bottom plate 19. The curved front edges of the plates 17, extending upwardly and rearwardly from a sharp point, are connected by a front plate 20 of such a width that the shuttle box 15, dragged along by the tool, can be moved without too much resistance through the trench dug by the tool. In order to ensure that the place where the drainage tube leaves the hollow shuttle box 15 lies always on the bottom of the trench, the shuttle box 15 is pivotally connected to the tool (or to the main beam 3 in Figure 2) at 21. In the embodiment shown in Figure 1 an adjusting piston cylinder actuator 22 is arranged between said shuttle box 15 and the upper side of said tool which actuator can be connected, whether operating as buffer element or not, to the main actuator 13 operating whether as buffer element or not.

The adjusting actuator 22 is operated so that the rear end of the shuttle box 15 remains constantly in contact with the trench bottom as a consequence of the buffer operation of said adjusting actuator 22. Operation as a buffer means that the relevant actuator is connected to a hydraulic accumulator (not shown) and therefore is effectively a resilient element.

In the embodiment represented in Figure 1 the main beam 3 is L-shaped with an upright arm forming one side of the parallelogram linkage and a rear horizontal arm directed forwards and at its free end supporting a horizontal pivot 24, about which the entire tool 14 can freely rock. The tool 14 is hollow and is open at the top, and the L-shaped main beam 3 is received in the interior of the tool 14. The included angle of the tip region 16 of the said tool lies between 20° and 45°.

When the tool 14 is to be driven into the earth, the actuator 7 is operated to tilt the member 4 and hence the beam 3 forwards, and the main actuator 13 is contracted as the tractor moves forwards, so that the point of the tool descends into the earth; when the tool has reached the required depth of the trench the contraction of said main actuator 13 is terminated; i.e. the descent of the tool ceases. In an undulatory area the stabilizing actuator 7 is operated by the automatical control device 8, whereas the operator operates the main actuator 13 so that the bottom plate of the tool 14 remains at the right depth. The entire tool 14 can rock freely about pivot 24. Because of this, when the tool is moved through the earth, the pressure which acts on the inclined front side 20 of said digging element at the position where the highest pressure arises, to wit at the point of engagement with earth, is transferred to the main beam 3 which is connected by the parallelogram system 2 to the vehicel, and consequently is absorbed by the vehicle. The crawler vehicle can also move forward and backwards to a limited extent without this having a significant influence on the rear side of the tool. The adjustment of said main beam 3 in the vertical or almost vertical direction by means of the parallelogram linkage 2 and the main actuator 13 acts to adjust the point of said tool without changing the position of the rear end of said tool.

In the embodiment represented in Figures 2 and 3 the rear portion of the tool 14 is rigidly connected to the main beam 3, whereas the point 16 can pivot about the pivot 24 and is rigidly connected to a lever 25, which is connected to a piston cylinder actuator 28 by a lever 27; the piston rod of actuator 28 is connected to the upper end of main beam 3.

Since the member 4 is connected through the parallelogram arms 9 and 10 to the main beam 3 and the bottom plate 19 of the tool 14 is integral with the main beam, the angle which the bottom plate 19 makes with the member 4 will remain constant. By adjusting the automatic control device 8 with respect to the member 4 a predetermined angle of the member 4 and hence of bottom plate 19 with respect to the crawler vehicle is set, and said angle is maintained by means of the

stabilizing actuator 7 irrespective of the position of the crawler vehicle. When the desired angle has been adjusted, the main beam 3 is driven vertically (or almost vertically) into the ground as the vehicle advances, by means of the main actuator 13, until the bottom plate 19 has reached the predetermined trench bottom depth. Hereby the sole of the pivotable tip region 16 is in a direct line with the bottom plate 19. After the desired depth has been reached, operation of the main actuator 13 ceases. When the crawler vehicle is moving, the point of the tool will split the earth, which will be lifted along the upper front side 20 of the tool 14. The vertical component of the pressure which acts on said front side 20 of said tool is absorbed by the bottom plate 19. When said pressure becomes too high on the front side 20 or when the bottom plate 19 cannot absorb all the vertical pressure, fluid under pressure can be applied to the lower end of the actuator 13 operating as a buffer, to absorb said too high pressure.

The controlling of the depth of trench to be dug is effected by adjusting the point 16 up or down by means of the actuator 28 and the levers 25, 27. By tilting the point 16 upwardly the earth is split by said point 16 on a line, higher positioned than the previous line, so that the bottom plate 19 will follow said higher line. By adjusting the point 16 downwardly the bottom plate 19 is made to follow a lower line. As a result of such adjustments the entire tool will, during the movement of the vehicle move vertically upward or downwardly respectively as a result of the operation of the parallelogram arms 9 and 10. Since the main actuator 13 can still move or be adjusted when out of operation or in buffer operation respectively, said main actuator will have no influence on the vertical adjustment of the tool. The tool 14 is not influenced by the crawler vehicle 1, since surface uneveness is compensated by the stabilizing actuator 7, which is operated by the automatic control deviced 8. Any variation in the difference of height between the pivot 11 and the bottom plate 19 is absorbed by the parallelogram arms 9 and 10 and the main actuator 13 being out of operation or serving as a buffer.

Figure 4 shows an embodiment in which the point or tip region 16 is fast with, e.g. a part of, the main beam 3, whereas the rest of the tool 14 can rock freely about the pivot 24. The insertion of the tool into the earth takes place in the same way as described in relation to the embodiment represented in Figure 1.

WHAT WE CLAIM IS:—

1. Apparatus for cutting a drainage trench, comprising a cutting tool mounted on supporting means for attaching the tool to a vehicle, the tool having spaced planar side members embracing the supporting means, and a front member spanning the spacing between the side members at the leading edges of the latter, the said leading edges and front member extending rearwardly and upwardly from a sharp tip of the tool at a lower forward extremity of the tool, and at least part of the tool being pivotable about a horizontal axis disposed close to the said tip.

2. Apparatus as claimed in claim 1 in which the tip region of the tool is fixed in relation to the supporting means, and the rest of the tool is pivotable about the said axis relative to the supporting means.

3. Apparatus as claimed in cllaiim 1 in which the tip region of the tool is pivotable about the said axis relative to the supporting means and the rest of the tool is fixed in relation to the supporting means.

4. Apparatus as claimed in claim 3 in which the said tip region is fast with a lever pivotable about the said axis which lever is coupled to an actuator coupled on the supporting means and is disposed within the tool.

5. Apparatus as claimed in claim 1 in which the entire tool is pivotable about the said axis with respect to the supporting means.

6. Apparatus as claimed in claim 2 or 5 in which the supporting means is a generally L-shaped member having an upright arm for attachment to a vehicle, and a generally horizontal arm with the said axis at the free end thereof.

7. Apparatus as claimed in claim 3 or 4 wherein the supporting means is an upright arm fast with the said rest of the tool.

8. Apparatus as claimed in any preceding claim wherein a shuffle box for receiving a drainage tube and laying it in the drainage trench is pivotably attached to the tool or the supporting means, at the trailing end of the tool.

9. Apparatus as claimed in any preceding claim when mounted on a tractor vehicle, the said supporting means forming one side of a parallelogram linkage which is mounted on the vehicle and is provided with actuating means for raising and lowering the supporting means.

10. Apparatus as claimed in claim 9, the parallelogram linkage being mounted on the vehicle for pivoting as a whole about a horizontal axis and an actuator being provided for effecting such pivoting relative to the vehicle.

11. Apparatus for cutting a drainage trench, substantially as herein described with reference to Figure 1, Figures 2 and 3 or Figure 4 of the accompanying drawings.

12. A crawler vehicle having mounted thereon apparatus as claimed in any of the preceding claims for cutting a drainage trench.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

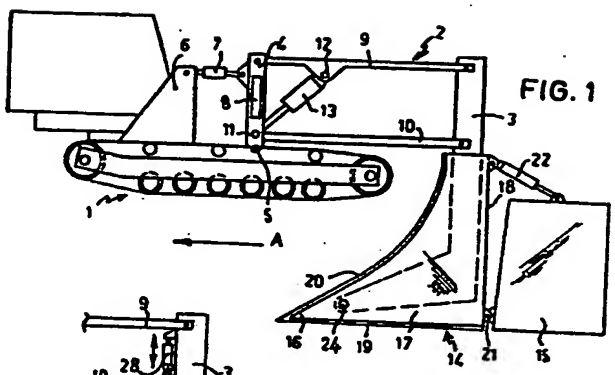

FIG. 1

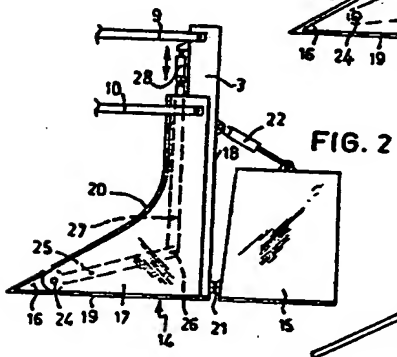

FIG. 2

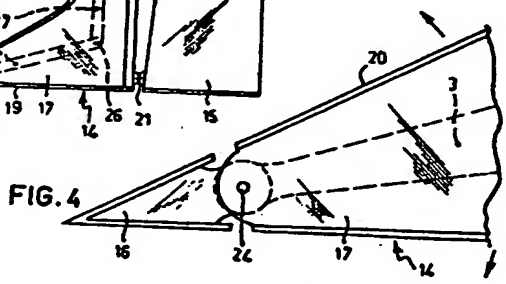

FIG. 4

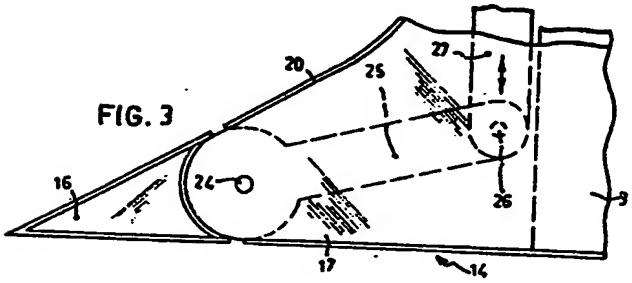

FIG. 3